Mathematical and Computer Modelling in Science and Technology

THE SEVENTH INTERNATIONAL CONFERENCE
Chicago, Illinois, U.S.A. August 1989

Edited by
Xavier J. R. Avula
University of Missouri-Rolla

PERGAMON PRESS

OXFORD . NEW YORK . BEIJING . FRANKFURT
SAO PAULO . SEOUL . SYDNEY . TOKYO

In order to make this volume available as economically and as rapidly as possible the typescript has been reproduced in its original form. This method unfortunately has its typographical limitations but it is hoped that they in no way distract the reader.

Copyright © 1990 Pergamon Press plc

All Rights Reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means: electronic, electrostatic, magnetic tape, mechanical, photocopying, recording or otherwise, without permission in writing from the publisher

Published as Volume 14 of the journal *Mathematical and Computer Modelling* and supplied to subscribers as part of their 1990 subscription. Also available to non-subscribers.

Printed in Great Britain by BPCC Wheatons Ltd, Exeter

CONTENTS

MATHEMATICAL AND COMPUTER MODELLING IN SCIENCE AND TECHNOLOGY

THE SEVENTH INTERNATIONAL CONFERENCE

Objective and Conference Organization xvii

Foreword

Xavier J. R. Avula xxi

PLENARY LECTURES

Modeling - From Primitive Brains to Hyperintelligence

George Bugliarello 1

New Mathematical Problems Arising in the Context of Information Technology

A. Bensoussan 4

Problems and Tools to Model Uncertainty in Expert- and Decision-Support Systems

H.-J. Zimmermann 8

On Deriving Models in the Social Sciences

Patrick Suppes 21

Mathematical Optimization in Multi-Disciplinary Design

V. B. Venkayya 29

Recent Advances in Mathematical Modelling of Materials Behavior

Josef Betten 37

METHODOLOGY

Several Epistemological Problems Related to the Concept of Systems

Yi Lin, Rick Port, and **Yonghao Ma** 52

Continuous Mappings Between General Systems

Yonghao Ma and **Yi Lin** 58

Nonintegrable Systems

Murray Muraskin 64

On Modelling Systems with Non-Synchronously Operating Impulse Elements

E. A. Asarin, M. A. Krasnosel'skii, V. S. Kozyakin, and **N. A. Kuznetsov** 70

Analysis of Acoustic Scattering in Fluids and Solids by the Method of Fundamental Solution

D. J. Shippy, P. S. Kondapalli, and **G. Fairweather** 74

Decomposition Solution of Nonlinear Hyperbolic Equations

G. Adomian 80

Convergence of Admonian's Method

Yves Cherruault 83

Multiparameter Direct Variational Solutions for Linear Dissipative Systems

Vuk M. Fatic 87

DESMOD - A Discrete Event Simulation Kernel

Prashant Waknis and **Janos Sztipanovits** 93

A Discrete Mathematical Model for Solving a Handshaking Problem and Proving Its Correctness

Diane M. Spresser 97

METHODOLOGY (cont.)

"What If" Analysis in Computer Simulation Models: A Comparative Survey with Some Extensions
H. Arsham and **A. B. Kahn** 101

Nonlinear Matrix Equations of the Riccati Type Arising in Mathematical Modelling and Simulation
John Jones, Jr. 107

A Parallel Preconditioned Block Conjugate Gradient Method for Solving Large Systems of Linear Equations on MIMD Supercomputer
Luis Vidal-Ascon, Thomas Grace, Perpetua Ruiz-Mostacero, and **Alberto Vidal-Ascon** 112

Hybrid Galerkin-Perturbation Method for Forced Oscillations of the Duffing Equation
Robert J. Telban, James F. Geer, and **James M. Pitarresi** 120

On the Development of an Integrated Knowledge Based Finite Element Analysis System
Yung Fan and **Stevens J. Fenves** 124

A Super-Element Approach for the Solution of Problems of the Boundary Value Type
Mikhail N. Mikhail 130

Automatic Grid Generation for Finite Element Models Using a Finite Element Package
Mikhail N. Mikhail 136

Numerical Modeling of Stefan Problems
N. S. Asaithambi 139

The Boundary Element Method Applied to a Moving Boundary Problem
Dennis W. Quinn and **Mark E. Oxley** 145

Conjugate Duality and Its Implications in Dynamic Programming
Cerry M. Klein 151

Analysis of Variance of Customer Balances for a Family of Stochastic Service Networks
Richard L. Patterson 155

Behavioral Modelling; Implications for Philosophy
Stanley Rush 161

Logo Aided Modeling in Secondary School Education: The Modeling of Elementary Statistical Experiments
Amal K. Shamma and **Janice L. Flake** 166

INFORMATION SYSTEMS

A Data Distribution Model for Distributed Relational Databases with Dissimilar Computers
Dalia Motzkin and **Patrick D. Yurk** 172

Performance Issues in Database Systems
Mukesh Singhal and **Yelena Yesha** 178

Modelling of Information Flow in Continuous Processing Media
Zinovy V. Reytblatt and **James R. Kenevan** 182

Modelling Contention Sensing Memory Management Systems: A VAX/VMS Case Study
Carl P. Singer and **Prabuddha Biswas** 184

Implementation of an Instructional Subsystem for a Simulator-Based Training Device on Apollo Workstation
G. Rama Mohana Rao 190

Closed Form Reliability Expression of a Large Non-Homogeneous Distributed System
Afzel Noore and **Steven B. Nestor** 196

Contents

SYSTEM IDENTIFICATION

Associate Memories for System Identification: Inverse Problems in Remote Sensing
Harriet Kagiwada, Robert Kalaba, and **Steve Timko** 200

On the Identification of Continuous-Time Multivariable Systems from Samples of Input-Output Data
S. Bingulac and **N. K. Sinha** 203

Interpretation and Solution of Ill-Conditioned Equations Arising in Parameter Estimation and System Identification
Irving U. Ojalvo 209

Compact Symmetrical Binary Codes for System Identification
Ian A. Henderson and **Joseph McGhee** 213

Nonlinear Modelling and Black Box Identification of a Hydrostatic Transmission for Control System Design
Luigi del Re 219

Mathematical Model Validates Multi-Peak Backscatter Detector Characteristics
Ian A. Henderson and **Joseph McGhee** 225

Calibration and Stochastic Modeling of a Laser-Gyro for Laboratory Testing
J. Aranda, J. M. de la Cruz, H. Ruiperez, and **S. Dormido** 231

OPTIMIZATION

A Stereographic Projection Method for Testing Equivalent Mean Directions in Interactive Optimization
Marvin D. Troutt and **M. Diane Pettypool** 237

A Mass Concept for Optimal Scaling in the Method of Abstract Forces
Marvin D. Troutt, Roy J. Clinton, Tom Hemming, and **M. Diane Pettypool** 240

Alienor, Fractal Algorithm for Multivariate Minimization Problems
A. Guillez 245

A New Method for Simultaneous Structural/Control Optimization
Michael Allen Vehmeier and **James Mark Pitarresi** 248

The Thermodynamically Best Journal Bearing
Robert L. Young 254

A System Optimization Model for Low Level Nuclear Waste Disposal
Shoou-Yuh Chang and **Angel L. Rivera** 257

Simulation and Optimization of Three Existing Ethylbenzene Dehydrogenation Reactors in Series
I. Onal, N. Yalcin, E. Uygun, and **H. Ozturk** 263

Calculating the Shortest Air Freight Routes in Illinois
William Conley 268

A Mathematical Model of Optimal Crutch Weight of Amputated Human From Ergonomics Point of View
Ashish Kumar Pradhan, Amiya Bhusan Roy, Sailesh Chandra Saha, Sunil Thakur, and **Ashish Kumar Kar** 274

Contents

NEURAL NETWORKS

Algorithm and Instrumentation for Isolated-Word Recognition
Nazeih M. Botros, Zoheir Deiri, and **Ihab Wattar** 279

Optimal Control for Training: The Missing Link Between Hidden Morkov Models and Connectionist Networks
Athanasios Kehagias 284

Neural Networks with Creative Dynamics
Michail Zak and **Jacob Barhen** 290

Molecular Dynamics of Short-Term Memory
Victor Eliashberg 295

A Comparative Study of Neural Network Models
S. Hudon, Y. Yan, and **W. Kinsner** 300

A Parallel Architecture of a Neuronal Machine to the Knowledge Acquisition, The Image Processing, and the Approximated Solution of Some Equations
A. Caron 305

Modeling the Biological Mechanisms of Vision
Michael R. Blackburn and **Hoa G. Nguyen** 311

Functional Models of Neurobiological Processes
William P. Coleman, David P. Sanford, Andrea De Gaetano, and **Fred Geisler** 317

Multiprocessor Acceleration of Cross-Coupled Neural Network Calculations
John M. Cavallo and **James B. Restorff** 322

Convergence Rates in Symmetric Neural Networks with Glauber Dynamics
R. H. Baran and **J. P. Coughlin** 325

Adaptive Kernel Neural Network
David J. Marchette and **Carey E. Priebe** 328

NASH Equilibria in Multineuron Games
Robert H. Baran and **James P. Coughlin** 334

CIRCUITS, NETWORKS AND POWER SYSTEMS

Fuzzy Network Model
Cerry N. Klein and **Jose A. Ventura** 336

An Algorithm for the Automatic Generation of Release Conditions for Single Entity Networks
Patrick Mui 340

Microcomputer Simulation of Semiconductor Junction Characteristics
A. K. Goel, J. L. Casey, and **M. Cobb** 344

Modelling of Parasitic Interconnection Inductances on the GaAs-Based VLSIC's
A. K. Goel and **Y. R. Huang** 349

Simulation of VLSI Processing Deficiencies in Digital Integrated Circuits
Afzel Noore 354

Compartmental Models for Data Network Dynamics
Mario R. Garzia and **Clayton M. Lockhart** 359

Evaluation of a Fan Out Stem Based Fault Simulation and Sequential Circuits
Frederick J. Hill and **Eltayeb S. Abuelyaman** 365

Mathematical and Computer Simulation Techniques in Reactive Power Compensation
S. Etminan, R. H. Kitchin, and **S. Sotudeh** 372

CIRCUITS, NETWORKS AND POWER SYSTEMS (cont.)

Modeling and simulation of Ultrafast Pulse Propagation in Microstrip Lines
O. R. Baiocchi, M. K. Webb, and **P. O. Kwok** 378
Computer Network From Satellite to Automobile
Ghulam H. Raz 383
A Model for Setting Complex Regulator Channels Parameters in Hydroelectric Power Systems
M. Serry Thaha 389

DYNAMICAL SYSTEMS AND CONTROL

Visualization of Strange Attractors
Michael P. Kirby, Nan C. Schallar, and **Joseph S. Torok** 395
Chaotic Dynamics of Sequential CSTR's
David G. Retzloff, Paul C-H Chan, and **Mir-Saeed Razavi** 400
Fixed Mode Elimination in Decentralized Control Systems Using Eigenvalue Sensitivities
Jorge R. B. Souza and **S. Vittal Rao** 406
A Computational Strategy for Active Control of Dynamic Systems via Minimizing the Displacement Magnitudes of Dominant Harmonics of Vibrations
Majid Rashidi 410
Construction of Control Design Models from Engineering Simulation Models
Robert A. Smoak and **Xavier R. Ollat** 413
A Balancing Method for Reduced Order Modelling of Unstable Systems
Rajiva Prakash and **S. Vittal Rao** 418
The Scanning Normal Forms of Linear Dynamic Systems with Variable Coefficients
Mark A. Pinsky 424
The Normal and the Scanning Normal Forms of Nonlinear Dynamical Systems
Mark A. Pinsky 429

ARTIFICIAL INTELLIGENCE AND ROBOTICS

Modelling of Edge-Based Visual Objects
Paul T. Hadingham 435
Robot Selection Decision Support system: A Fuzzy Set Approach
Chao-Yen Wu 440
A Multiprocessor Testbed for Exploring Parallel Algorithms in Robot Dynamics
Kasi Anantha, Marko Vuskovic, and **Ting Liang** 444
Microcomputer-Based Robot Arm Control
Rafil I. Noorani 450
Dynamic Modelling of a Robot Sensor
D. T. Pham and **K. Hafeez** 456
Simulation and Optimization of Gait for a Bipedal Robot
P. H. Channon, S. H. Hopkins, and **D. T. Pham** 463
Dynamic Modeling of a Laminated Composite-Material Flexible Robot Arm Made of Short Beams
N. G. Chalhoub, F. Gordaninejad, Q. Lin, and **A. Ghazavi** 468
Force Control of High-Speed, Lightweight Robotic Manipulators
H.-J. Su, B.-O. Choi, and **K. Krishnamurthy** 474
Computer Simulation in an Industrial Parallelogram Robot with Mechanical Compliance
Pierre J. DeSmet, Eugene I. Rivin, and **Yongle Lou** 480

Contents

MOLECULAR DESIGN

Mathematical Models and Computer Enumerations of Polymers with Loops
D. E. Burnette and H. A. Lim 486

Generalized Tube Model of Biased Reptation for DNA-Gel Electrophoresis
Hwa A. Lim, Jaan Noolandi, and Gary W. Slater 494

Modelling in Drug Discovery and Development -- The Search for Isomorphisms
William J. Netzer 500

An Estimation of the Atomic Contribution to Octanol-Water Partition Coefficient and Molar Refractivity from Fundamental Atomic and Structural Properties and Their Uses in Computer Aided Drug Design
Vellarkad N. Vishwanathan, Arup K. Ghose, Ganapathi R. Revankar, and Roland K. Robins 505

A Graph Theoretic Approach to Predicting Molecular Properties
Subhash C. Basak, Gerald J. Niemi, and Gilman D. Veith 511

3-Hydroxy-3-Methylglutaryl-Coenzyme A Reductase: Three-Dimensional-Structure-Activity Relationships and Inhibitor Design
I. Motoc, W. E. Harte, S. Y. Sit, N. Balasubramanian and J. J. Wright 517

BIOMEDICAL SYSTEMS AND BIOLOGICAL SCIENCES

A Mathematical Model of the Proximal Nephron
Alan M. Weinstein 522

Use of Physiological Connectivity in Solving Renal Concentrating Mechanism Equations
R. P. Tewarson and J. L. Stephenson 529

Distributed Loops of Henle in a Central Core Model of the Renal Medulla: Where Should the Solute Come Out?
H. E. Layton 533

Acid-Base Transport in the Renal Thick Ascending Limb
Reymond Mejia and Mark A. Knepper 538

Analysis of a Model of a Nephron of a Kidney Having a Multitube Postglomerular Capillary
J. B. Garner 543

Design Considerations for a Pregnancy Model for Warfarin
Walter D. Wosilait and Richard H. Luecke 547

Mathematical Analysis of a Novel Bioartificial Pancreas Design for the Control of Type I Diabetes
Jeffrey G. Sarver and Ronald L. Fournier 551

Kinetic Analysis of Stimulus-Induced Insulin Release in Thyrotoxic and Normal Subjects
Jayendra H. Shah, Dabir S. Viswanath, and Sudhir S. J. Batchu 557

In-Vitro Simulation of Physiological and Pathological Conditions: Effect of Temperature on Urine Microalbumin Concentration
Jayendra H. Shah, Sudhir S. J. Batchu, Thomas E. Edes and Dabir S. Viswanath 562

Fractal Model of the Hematoocular Barrier: Verhulst Dynamics and Mathematical Modelling of the Inflow and Outflow Values
Nikola Stambuk 565

BIOMEDICAL SYSTEMS AND BIOLOGICAL SCIENCES (cont.)

Variability of Pressures and Rates in the Human Cardiovascular System -- Is It Chaos or Old Fashioned Noise?
F. Eugene Yates and **Laurel A. Benton** 571

Computer Simulation of Ventricular Fibrillation and of Defibrillating Electric Shocks. Effects of Antiarrhythmic Drugs
Pierre Auger, Alain Bardou, Alain Coulombe, Marie-Claude Govaere, Luc Rochette, Jean-Pierre Schreiber, Dominique von Euw, and **Michel Chesnais** 576

A Model of the Carotid Vascular System with Stenosis at the Carotid Bifurcation
W. Kinsner and **Y. Yan** 582

Chaos in Coupled Nonlinear Gastric Oscillators
Peter E. Hanson, Berj L. Bardakjian, and **Nicholas E. Diamant** 586

Mathematical Modelling of Protein Secretion Across the Endoplasmic Reticulum
Ujwal P. Shinde, Vikram S. Ghole, Madhumati R. Mawal, and **Yogesh R. Mawal** 592

A Nonlinear Model for DNA Dynamics
V. Muto, A. C. Scott, and **P. L. Christiansen** 600

A Mathematical Model for the Cellular Dynamics and Labelling Kinetics Governing the Response of Rat, Mouse, Hamster, and Guinea Pig Hepatocytes to Methylclofenapate
T. R. Auton, M. A. Kelly, and **J. A. Styles** 604

Clinical Usefulness of Multivariate Autoregressive (AR) Modeling as a Means for Analyzing T-Lymphocyte Subset Fluctuations
Takao Wada, Haruyasu Yamada, Hiroshi Inoue, Takenobu Iso, Elichi Udagawa, and **Shigeomi Kuroda** 610

Limit cycles in a Kolmogorov-Type Model and Its Application in Immunology
Xun-Cheng Huang 614

A Stochastic Model for the Induction of Heritable Translocation in Spermatozoa by Exposure to Environmental Agents
W. Y. Tan and **Chao Chen** 618

Cancer Models and Advances in Simulating Radiation Therapy
W. Duchting 623

A Mathematical Model for the Survival of Skin Melanoma Patients
Jian C. Chang 629

Assessing the Effects of Intervention of AIDS Development Induced by Blood Transfusion
W. Y. Tan and **F. Shamsa** 635

An Aids Model with Screening
Ying-Hen Hsieh 640

A Stochastic Model for AIDS Epidemic Involving Several Risk Populations
W. Y. Tan 644

Threshold Models in Occupational Epidemiology
Kurt W. Ulm 649

Research in Computational Epidemiology
T. Habtemariam, D. Oryang, F. Gabreab, V. Robnett, and **G. Trammel** 653

Some Results on a SIRS Epidemic Model with Subpopulations
Xiadong Lin and **Joseph W.-H. So** 659

A Stochastic-Mechanical Model for Mammalian Long Bone Growth
Wen-Fang Wu 662

BIOMEDICAL SYSTEMS AND BIOLOGICAL SCIENCES (cont.)

Using Conic Curves to Classify Pathomechanical Biostructures of the Metatarsus
P H. Demp 668

Hierarchial Processes in Biological Systems
Allessandro L. Kovacs 674

Dynamics in Hierarchically Organized Systems: Biological Examples
Pierre Auger 680

A General Method to Characterize Homogeneous Neuronal Populations
Richard L. Port and **Yi Lin** 686

Morphogenesis of Liposomes and Bending Energy of Lipid Bilayer
Toshio Sekimura and **Hirokazu Hotani** 690

A Report on Evolutionarily Stable Strategy: Modelling the Effects of Behavior on Evolution
W. G. S. Hines 694

Statistical Mechanics in Ecological Hierarchies
Robert M. Seymour 699

Future for the Great Barrier Reef Ecosystem
J. D. Van der Laan and **R. H. Bradbury** 705

FLUID MECHANICS

Implementation of a Three-Dimensional Navier-Stokes Code on the Symult Series 2010
Christopher J. Catherasoo and **Ramesh K. Agarwal** 710

Computational Fluid Dynamics on Connection Machine
H. Thomas Sharp, Lyle N. Long, and **Mohammed M. S. Khan** 714

Lattice-Gas Automation Simulation of Simple Fluid Dynamical Problems
H. A. Lim 720

Development and Application of an Integral Method for the Incompressible Navier-Stokes Equations
M. Nair and **F. R. Payne** 728

Pressure Gradient Method for solving Incompressible Navier-Stokes Equations with Curvilinear Coordinate System
Cha Hsiang Tan, Michael Pecht, and **J. C. Duh** 732

Running Large Air Pollution Models on the High Speed Computers
Zahari Zlatev 737

Computer Modelling of Superimposed Inviscid Flows on a Microcomputer
William G. Culbreth 741

A Model for Compressor Flow Instability with Mode Shifting
Morten Brons 746

An Extension of Danckwerts Theoretical Surface Renewal Model to Mass Transfer at Contaminated Turbulent Interfaces
Winston Khan 750

Turbulence Modelling in Pipe-Flow
A. Malhotra and **Kasem H. Mousa** 755

A Matched Asymptotic Model for Acoustic Propagation in an Ocean with a Rough Surface
Michael D. Collins 761

FLUID MECHANICS (cont.)

Exact Solution of the Helmholtz-Weyl Composition Equation in Underwater Acoustics -- The Quadratic Profile
Louis Fishman 765

An Extension of Underwater Explosion Models to Include the High Frequency Transients Following Pulse Maxima
A. E. Leybourne 771

Permeation of a Liquid Drop Through a Thin Membrane
J. Stastna, D. De Kee, B. Harrison, and **A. Asfour** 776

Applications of a New Variational Technique for the Study of Seepage as a Free Boundary Problem
S. M. Makky and **A. Ibrahim** 781

Modelling of a Solid Particles in Fluidized Beds
Mehrdad Massoudi and **Edward J. Boyle** 785

HEAT TRANSFER

Mathematical Modelling of Liquid Droplet Combustion in Microgravity
S. Y. Cho, R. A. Yetter, and **F. L. Dryer** 790

Fire Spread in a Three-Dimensional Pressure Vessel with Radiation Exchange and Wall Heat Losses
J. Raycraft, M. D. Kelleher, H. Q. Tang, and **K. T. Yang** 795

Evaluation of Liquid Phase Temperature of a Burning Droplet Through Mathematical Modelling
C. P. Sarathy, R. Natarajan, and **V. N. Vedamurthy** 801

Convection Eversion in a Circular Tube
G. S. H. Lock and **S. Park** 805

Free Convection in a Slender, Laterally-Heated Cavity: Inclination Effects
G. S. H. Lock and **J-C. Han** 810

Heat Transfer in the Thermal Entrance of Non-Newtonian Fluid Flow
Rama Subba Reddy Gorla 814

The Nonlinear dynamics of Solidification of a Binary Melt with Nonequilibrium Mushy Region
Valeri M. Mansurov 819

The Laminar Flow Field in a Near-Vertical Closed Tube Thermosyphon
G. S. H. Lock and **L. Zhao** 822

Modelling and Computation of Designs for Multistage Heat Exchanger Systems
A. Malhotra and **S. B. Muhaddin** 826

Optimization of the Controlling Design Parameters of Fluidized Bed Gas-Solid Heat Exchangers
V. N. Vedamurthy, T. Janakirajan, S. Natarajan, and **C. P. Sarathy** 832

Mathematical Modelling of Heat and Mass Transfer in Three Phase Fluidized Bed Systems
Anand A. Samuel and **V. N. Vedamurthy** 837

STRUCTURES AND MATERIALS

Thermal Mismatch Study in a Ceramic-to-Metal Joint Using Finite Element Method
Kamal Sarkar, Steven E. Sund, D. Bose, and **John Yamanis** 842

Higher Order Hierarchical Plates and Curved Shell Elements Based on P-Approximation in the Thickness Direction
Karan S. Surana and **Robert M. Sorem** 849

On the Formulation of Boundary Equations for Orthotropic Cylindrical Shells
Ke-Gang Shih and **Anthony N. Palazotto** 855

Finite Element Stability Analysis of Curved Beams on Elastic Foundation
M. R. Banan, G. Karami, and **M. Farshad** 863

The Application of Rik's Technique to Shell Snapping
C. T. Tsai and **A. N. Palazotto** 868

Buckling and Postbuckling Behaviour of Gabled Frames
Andreas S. Vlahinos and **Alfredo Cervantes** 873

On the Implementation of an Equilibrium Finite Element Method for the Numerical Solution of Plate Bending Problems
Lucia Della Croce and **Terenzio Scapolla** 877

Pangaea to Seven Continents -- A Rational Qualitative Earthquake Engineering Approach
S. F. Borg 883

Pseudo-Body Force Boundary Element Method for Thermo-Plastic Problems
G. Karami 889

Higher-Order Shear-Deformable Two Dimensional Hierarchical Beam Elements for Laminated Composites
Karan S. Surana and **Steve H. Nguyen** 893

Analytical and Numerical Approaches for Heat Conduction in Composite Materials
K. C. Chang and **U. J. Payne** 899

Computational Simulation of Internal Damage Accumulation in Filamentary Composite Material Systems
Kerry T. Slattery and **Robert M. Hackett** 905

Finite Element Application of a Bounding Surface Plasticity Model
Ameir Altaee, Erman Evgin, and **Bengt Fellenious** 909

A Mathematical Model for Soils
Erman Evgin and **Ameir Altaee** 915

Numerical Modelling for Large Deformation of Aggregates of Particles with Meta-Stable Structures
Ching L. Liao and **Ching S. Chang** 921

Computer Simulation of the Mathematical Modelling Involved in Constitutive Equation Development via Symbolic Computations
H. Q. Tan, S. M. Arnold, and **X. Dong** 927

Modelling the Thermo-Mechanical Behavior of a Carbide Inclusion in a Nickel Superalloy Including Residual Stress Effects with a Simple Finite-Element Model
Stuart McHugh 933

Inelastic Analysis of Variable Stiffness Members
Demeter G. Fertis and **Rajesh Taneja** 942

STRUCTURAL DYNAMICS

Head and Neck Dynamics in an Automobile Rollover
N. Yoganandan, Abdullah Almussallam, and **Anthony Sances, Jr.** 947
Ride Comfort and Stability Analysis of a Sports Car Using Multibody Dynamic Simulation
Parviz E. Nikravesh and **Gwanghun Gim** 953
Crashworthiness Analysis of a Truck
Jorge A. C. Ambrosio, Parviz E. Nikravesh, and **Manuel S. Pereira** 959
On the Stability of a Flexible Missile Under an End Thrust
Ardeshir Guran and **K. Ossia** 965
Stokesian Dynamics Simulation in the Presence of Interparticle van der Waals Forces
D. T. Wadiak, M. Seel, A. B. Kunz, and **S. E. Hill** 969
Automated Search for the Most Critical Flutter Configuration in Uncertain Models
Georges A. Becus 977
Nonlinear Flutter of Composite Laminated Plates
L. C. Shiau and **L. T. Lu** 983
Mathematical Modelling for Lateral Dynamic Simulation of a Railway Vehicle with Conventional and Unconventional Wheelset
P. M. Jawahar, K. N. Gupta, and **Echempati Raghu** 989
Motion of a Rectangular Bar Under Traction on a Horizontal Plate
D. T. Pham and **K. C. Cheung** 995
A Continuous Mass Model for Predicting the Elastodynamic Behavior of Rocker in a Planar 4-Bar Linkage Having Elastic Coupler and Rocker
Keshav C. Makwana K., K. N. Gupta, and **Echempati Raghu** 1002

INDUSTRIAL PROBLEMS

A Manager's View of Computer Aided Manufacturing
E. G. R. Gerelle and **Ph. G. Kirmser** 1008
Applying Artificial Intelligence Techniques to Modelling Manufacturing Systems
Keith Popplewell 1014
Shape Matching Using Optimization Techniques
Jose A. Ventura and **Cerry M. Klein** 1020
Finite Element Study of a Workpiece in a Machining Fixture
D. T. Pham and **A. De Sam Lazaro** 1024
Conceptual Modelling of Industrial Production/Distribution Systems via Standard Forms
A. L. Del Vecchio and **D. R. Towill** 1029
Some New Approaches for Designing Cellular Manufacturing Systems
R. Meenakshi Sundaram 1035
Model of Cell Supervisor Decision Support Systems
K. Vinodrai Pandya, R. Sotudeh, and **P. R. Bunn** 1040
Calibration Interval Determination as a Markovian Decision Process
Carlos Ford-Livene and **Tadao Mukaihata** 1046
The Mathematical Modelling and Computer Simulation of Chromatographic Systems Used in Chemical and Biochemical Applications
G. Ganetsos and **P. E. Barker** 1052
Mathematical Modeling of an Age-Forming Process
John Peddieson, Jr. and **George R. Buchanan** 1057

INDUSTRIAL PROBLEMS (cont.)

Numerical Aspects of Modelling Glass Pressing Processes Using the TLM Technique
S. H. Pulko and **C. P. Phizacklea** 1061
Simulation of Chip Form Estimation and Control for Lathe Turning
Thomas L. Ward, Patricia A. S. Ralston, and **Kenneth E. Stoll** 1067
Grinding Process Simulation in a Ballmill
Stanislaw Tarasiewicz and **Peter Radziszewski** 1072
Oil-Fired Boiler Simulation
Stanislaw Tarasiewicz and **Peter Radziszewski** 1075
A Cyclic Integer Covering Problem
Gotz Uebe, Martin Schafer, and **Reinholdt Kitta** 1079
A Goal Programming Model for Aggregate Inventory and Distribution Planning
D. C. Brauer and **G. Naadimuthu** 1085
Using Incomplete Prior Information in Statistical Quality Control: Performance of a Sampling Scheme and Estimation of its Parameters
Wilfried Seidel 1091
The Distribution of the Run Length of the Combined Shewhart-Cumulative Score Quality Control Procedures
Mototeng M. Ncube and **Shawky E. Shamma** 1096
Modelling and Simulation of an Automatized Warehouse in Activity
K. Oussou Hounkonnou 1100
A Computer Simulation of a Multiple Track Rail Network with Simultaneous Graphical Display
Samuel M. Graff 1103
Computer-Aided Modelling and Simulation of Technological Surfaces in the Stochastic Case
R. Pasquino and **A. Repaci** 1108
Computer Modelling of Open Punching Processes
Lin Zhiping and **Jiang Xiongxin** 1111
A Techno-Economic Model for Determining the Critical Energy Ratio of Co-generation in Process Industries
V. N. Vedamurthy and **C. P. Sarathy** 1117

MODELING IN DEFENSE PROBLEMS

Methodology of an Event-Driven Monte Carlo Missile Simulation
Mary Robin Holliday 1123
A Distributed Tactical Battle Data Transaction Management System
William Perrizo 1129
Analysis of Sensor Resources Development in an Escape/Evasion Scenerio
Mark R. Fernandez and **James E. Miller** 1134
Simulation of a Distributed Query Processing Algorithm on Token Ring Networks
William Perrizo and **V. Vananupong** 1140
Modeling of Residuals in a Test Data Optimal Processor-TDOP-of a Vehicle Trajectory
Shawky E. Shamma 1144

ECONOMICS/TRANSPORTATION/RESOURCES

The Arrow-Debreu Model of General Competitive Equilibrium in a Monetary Economy
Vladimir J. Simunek 1150

Analyzing Alternative Economic Policies with a Small Multi-Country Macroeconomic Model
James R. Malley 1155

Probabilistic Dimension of the AHP Approach to Input-Output Analysis: A Note
Reza Banai-Kashani 1161

On the Reliability of Quasi-T-Statistics: Some Monte Carlo Results
Saleh Amirkhalkhali, U. L. Gouranga Rao, and **Samad Amirkhalkhali** 1164

Error Analysis: A Tool for Selecting Travel Demand Models
Ramakrishna R. Tadi and **Snehamay Khasnabis** 1170

Renewable Resources and Pollution
Martin Schafer 1177

A Thermodynamic Setting for the Phillips Curve
Dennis Collins 1183

AUTHOR INDEX 1189